1.3 Functional Decomposition

1.3.1 Function Determination

To better understand what our product must accomplish, a functional decomposition was performed. A functional decomposition breaks down the overarching function of a design into smaller, basic functions that cannot be broken down further. To gain background information on shock absorbers, we researched how “long travel” automobile suspension works. With this background knowledge, we then thought about what would physically happen, step-by-step, if the lander impacted the lunar surface with a similar type of shock absorber. As we thought about this, we created a list of basic functions that the design must accomplish, then we grouped the basic functions into systems that accomplish a related function. We determined that our project has three systems: support, impact reduction, and reusability. After the basic functions were sorted, we constructed a functional decomposition hierarchy chart, Figure 1, and we were able to identify additional basic functions.

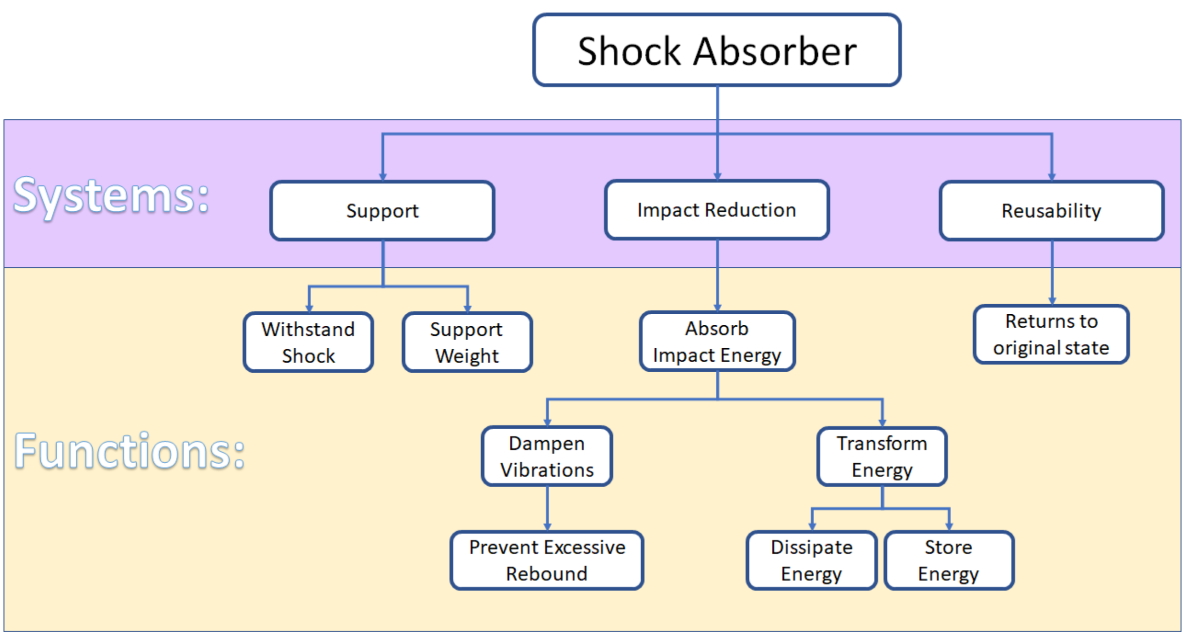

Figure 1. The functional decomposition hierarchy chart.

1.3.2 Function Ranking

After the basic functions were identified we had to determine the priority of the functions, i.e. which functions were the most important. To do this we constructed a cross reference table, Table B-1 in the appendix, and used a bitwise comparison method to compare the function of a row to the function of a column. If the row was deemed a more important function than the column it was given a 1, otherwise it was given a 0. The sum of the rows was taken and the row with the highest tally was deemed the most important function. The priority rank of all the functions is given in Table 2.

Rank	Function
1	Absorb Impact Energy
2	Withstand Shock
3	Support Weight
4	Return to Original State
5	Prevent Excessive Rebound
6	Transform Energy
7	Dampen Vibrations
8	Dissipate Energy
9	Store Energy

Table 2. Ranked priorities of the product functions

We were somewhat surprised to see that 'return to original state' is the 4th highest priority. Since the project brief centered around the reusable aspect of the design, we assumed that it would rank first, which may realign some of our concept's focus. It is interesting that the highest ranked function and all the lowest ranked functions come from impact reduction. The support system ranks higher than the reusability system, which will most likely affect our design concept focus.

1.3.3 Action and Outcomes

The overall action of the design will be to impact the moon, and the expected outcome is to do it multiple times safely. Absorb impact energy is the highest-ranking function for the design followed by the ability to withstand shock. The absorption of impact energy and ability to withstand shock, will ensure the safety of the contents of the human lander.

1.3.4 Connection to Systems

The three main systems that we determined were support, impact reduction, and reusability. The support and impact reduction are the functions that make the human lander system serve its function of getting to the moon and are therefore required in our design. Reusability is what our sponsor has emphasized and what makes this design unique from previous shock absorbers used for human lander systems.

Generally, functions are combined as much as possible, but we are trying to separate out the many functions of automobile shock absorbers that are accomplished by single parts. The ‘store energy’ function and ‘dissipate energy’ function may be integrated like they are in vehicle shock absorbers, but we do not want to assume that they need to be. Both may not be required if energy can be stored in a useful capacity or if the energy can be dissipated quickly enough. The ‘absorb impact energy’, ‘support weight’, and ‘withstand shock’ functions may be combined as well, like in automobile shock absorbers, but we did not want to assume that they needed to be.

1.3.5 Function Resolution

The design will ensure a safe landing on the moon through reusable shock absorbers with the ability to absorb impact energy, withstand shock, and support the weight of the human lander and its cargo. The design will be able to transform energy, dampen vibrations, dissipate energy, and store energy allowing for the safest landing possible.